PRACTICAL POSSIBILITY TO MANAGE RADIATION POLLUTION ON THE EXAMPLES OF THE REGION OF KRIVOY ROG AND LOIRE RIVER

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There is possibility dynamically to influence on the degree of radio-active contamination of running surface waters by the change of the modes of functioning of water objects and change of the modes of ejections of NPP. Thus positive results can be got not diminishing the amount of the contaminations thrown down in a water. Possibility of the dynamic influencing is supposed by the presence of dynamic adequate model of distribution of radio-active contamination.

The possibilities for managing on the consequences of accidental events of volley inflow of the muddy ^{238}U mine waters in the Zoltaja River (in the region of Krivoy Rog, Ukraine) and some possibilities to manage on the consequences of ^{3}H ejections in the Loire River basin (France) are presented in the work.

As a dynamic model was used the new box model of partial mixing with lagging argument (UNDBE) which increased accuracy and was developed by author. The model takes into account time of transporting of water masses and intermixing of contamination in some part of volume of the camera at the moment of termination of transporting. The new model is simple, less requiring for full-scale measurements, short time of computation. Short time of calculation gives the opportunity to solve the task of parameters identification. It contributes to increase the accuracy of the model and provides the possibility of its adjustment to a particular water object. The comparison of results of the exercise shows that box model UNDBE gives coincidence with measurements not worse of the more complicated 1D models [1- 4].

One of the main problems accumulated for 120-years-old exploitation of the Krivoy Rog metalliferous deposit the necessity of taking up 40 - 45 million m^3/year mine and annual utilization quarry waters highly mineralized in the volume of 20 - 25 millions m^3/year (see Fig. 1).

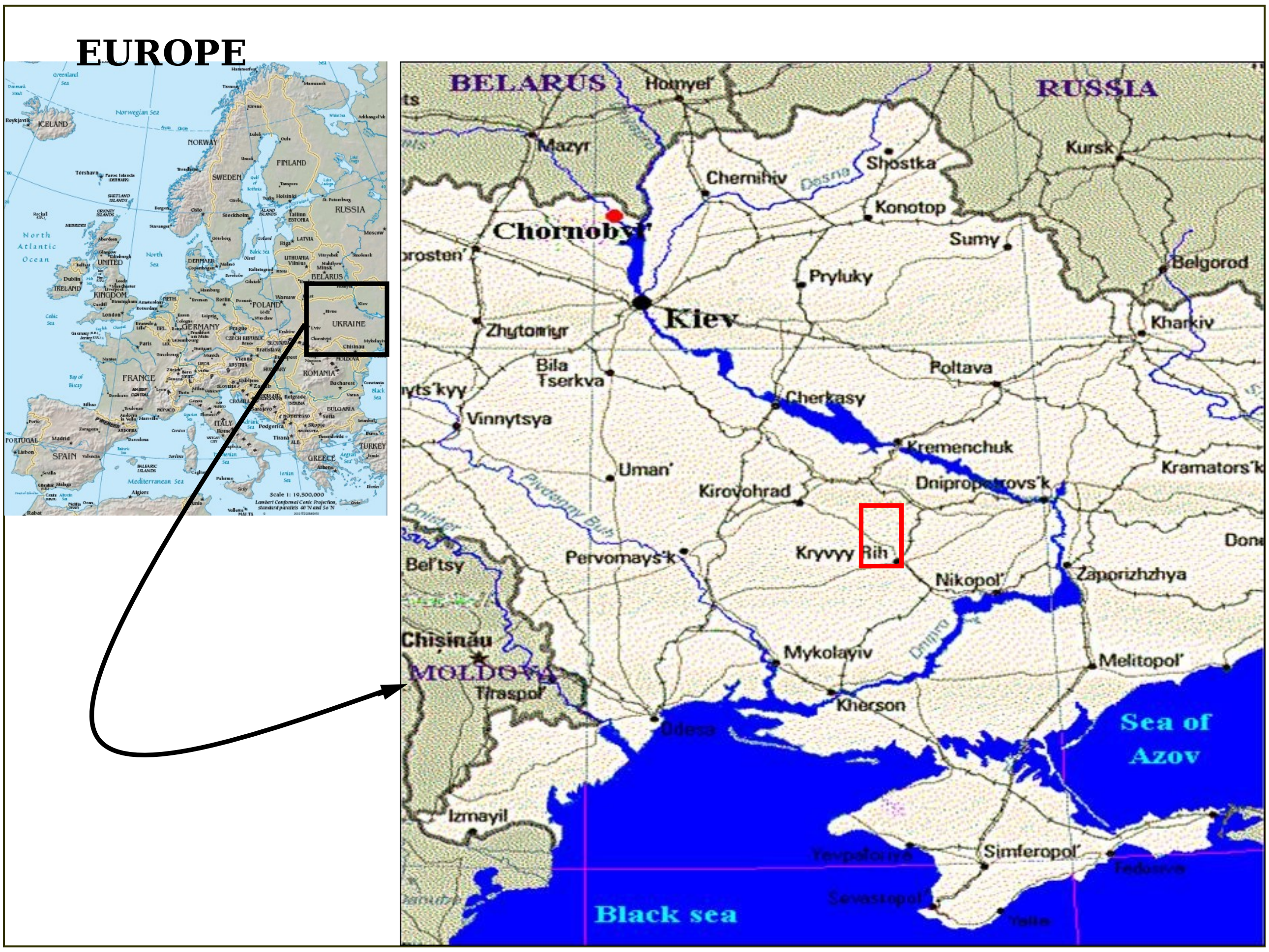

Fig. 1. Krivoy Rog region.

Uranium deposit located near-by Zoltje Vody City in the region of Krivoy Rog is one of the largest on territory of Ukraine. One of main mining objects of the city is a mine «Nova», which works mine of ferrous and uranium ores. Mine water which is pumped out on a surface saturated by uranium, sulfides, chlorides and is used for the technological necessities of mining complex and farther brushes off in tailing dump from where surpluses of water brush off in a Zoltaja River. This in the turn, results in contamination of waters of Ingulets River and Karachunovskoe reservoir - basic source of water-supply of whole region.

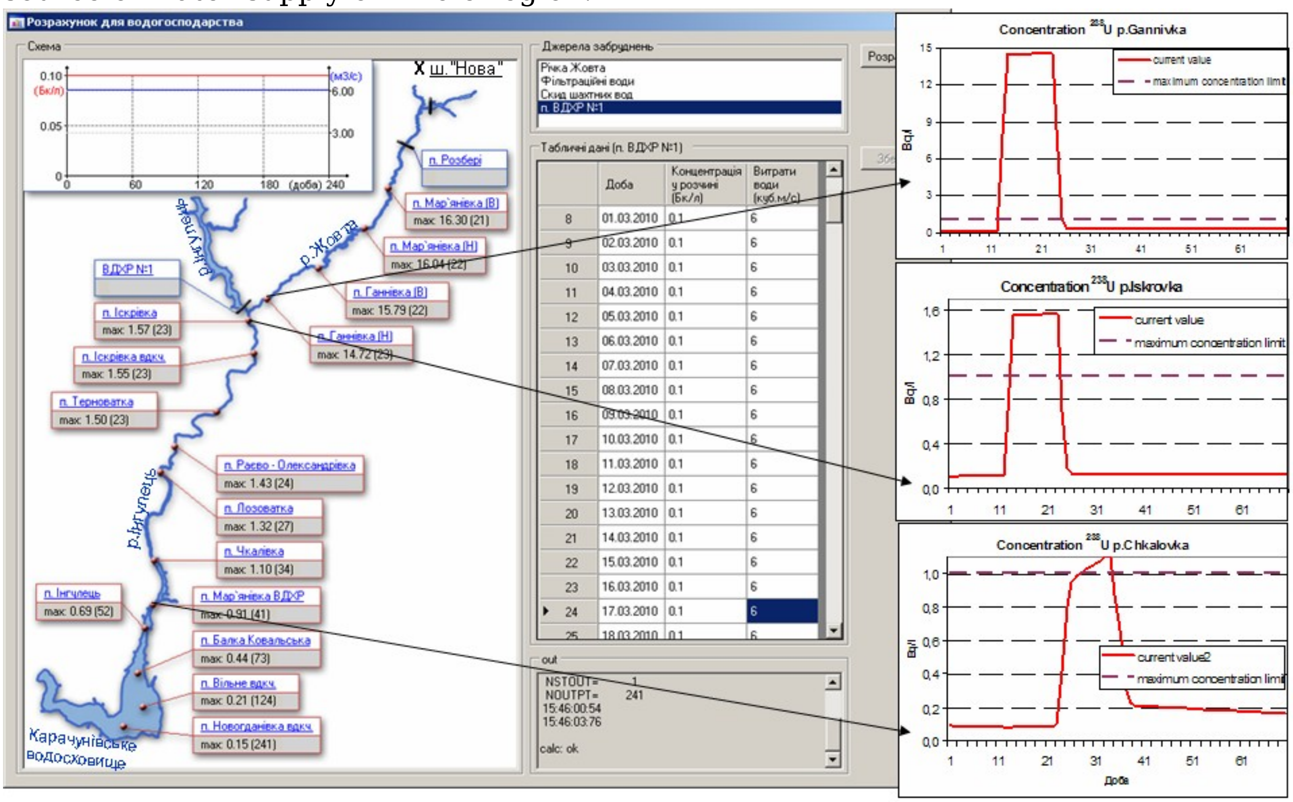

Fig. 2. Interface of user. Escape of mine water (^{238}U) to Zoltaja River - Ingulets River - Karachunovskoe reservoir.

Possibilities of water protection actions are explored at the catastrophic discharge of mine water to Zoltaja River. Protection action is dilution by waters from the storage pool of Ingulets River. Such measures in many cases enable to access to safe and adequate water and sanitation services during the catastrophic events. The new model gave the opportunity for accurate prognostication and short time of preparedness (less one minute). Time of water transportation from mine «Nova» to storage pool of Ingulets River more one day. So we have time for modeling and decision-making. Concentrations are shown in three points along Zoltaja River - Ingulets River when five days ejection of pollution occur on the Fig. 2.

It is possible to count different scenarios of water discharge from storage pool of Ingulets River fast and find time and minimal water discharge for decreasing concentration below maximum concentration limit. Resultes are shown on Fig. 3. Water discharge increased from 6 to 10.1 m^3/sec.

The program complex has been introduced in the Ukrainian state water-protection organization (Derzvodgosp).

The research of emissions tritium in the channel of 350 kilometers of the Loire River (France) (Fig.4) was made in the framework of the IAEA program EMRAS (Environmental Modelling for RAdiation Safety) [3]. Information of the in-situ

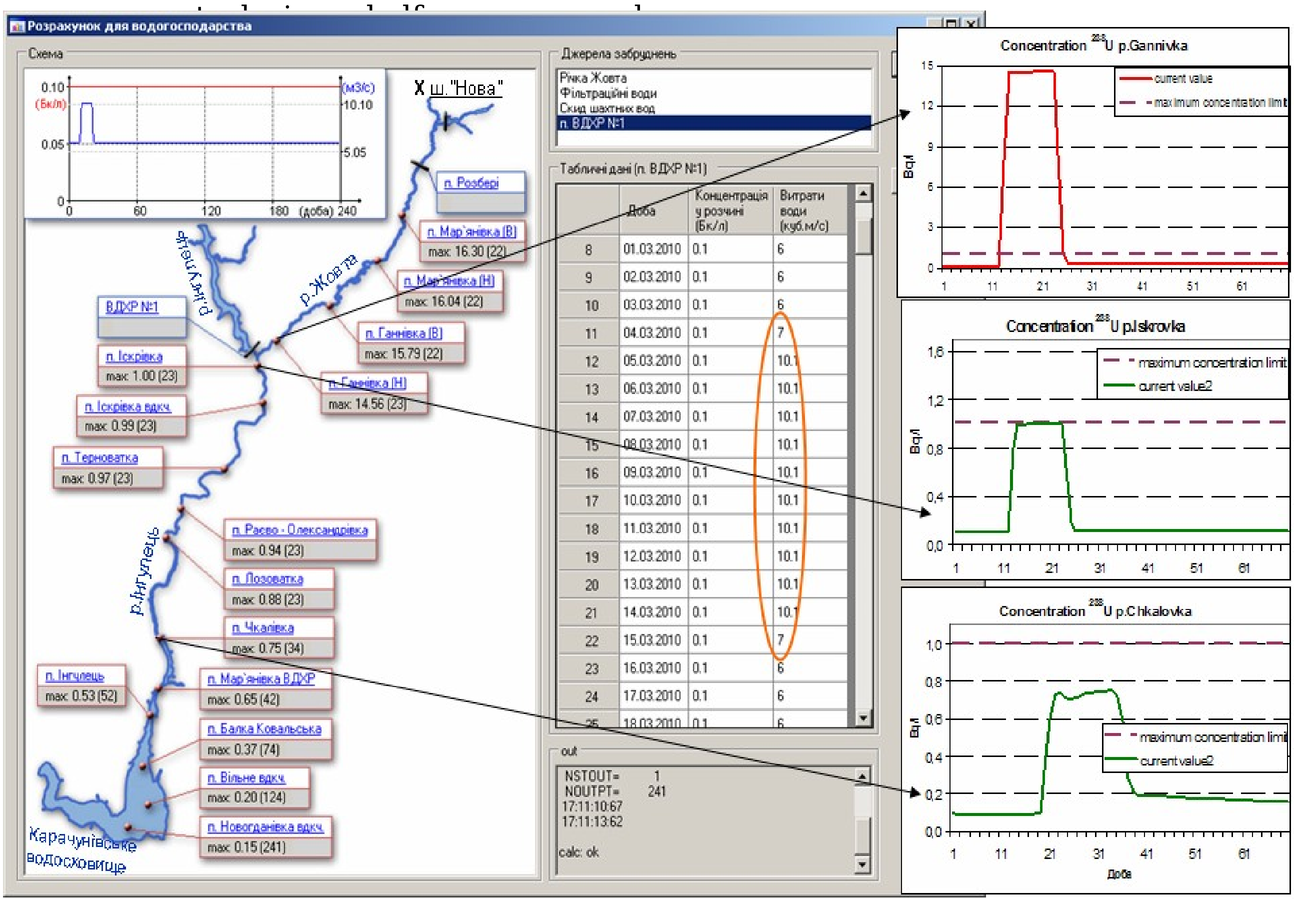

Fig. 3. Escape of mine water (^{238}U) to Zoltaja River - Ingulets River - Karachunovskoe reservoir & water protection

emissions remains without modifications. The search of favorable combinations of moments of the ejections can be done with the help of modeling.

Example of scenario calculation with the changed moments of some separate ejections of tritium for points Nouan (point after NPP StLaurent) and Angers during half year are resulted on Fig. 5, Fig. 6. The brown line is concentration of ^{3}H before and the orange line after changing moments of ejections. Each scenario calculation for 33 points along the river with an hour time discretization needs 2 minutes computer time.

A decline of maximal concentration of ^{3}H is 20-30% for different points along the river.

Radical another way to influence on the size of concentration consists of that, “to collect all of the ejections in one” from different NPP so that the total ejection coincided with the maximal of water discharge (it was strongly dilute).

The scenario calculation “to collect all of the ejections in one” from all NPP in

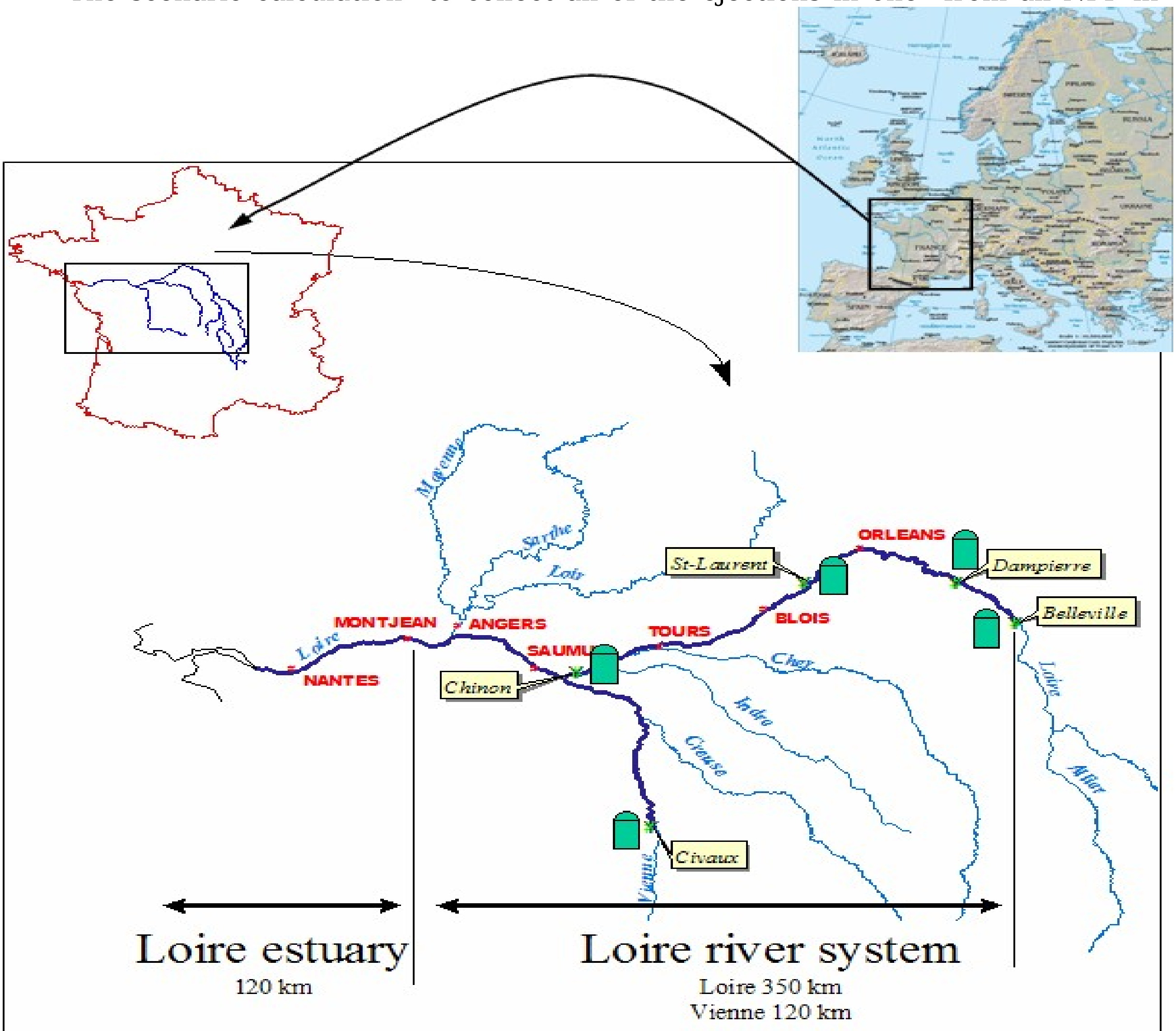

Fig.4. Loire River basin [3]

Conclusions:

- a new box model of incomplete interfusion with lagging argument provides the increase of exactness of modeling without considerable complication of mathematical tool due to the account of time of transporting of water masses and more exact account of diffusion;
- a program complex with the offered model allows to forecast the transport of contaminations in flowing surface water. It needs less full-scale measurements and short time of computation;
- small time of computation makes possible parametric identification of model and also the work in the mode on line. It gives the possibility of adaptation of model to the object, use in early warning systems and decision support systems;
- the regimes of exploitation of HPP and NPP can be used as measures of water protection in the normal emissions of contamination and in conditions of emergency emissions of contamination.

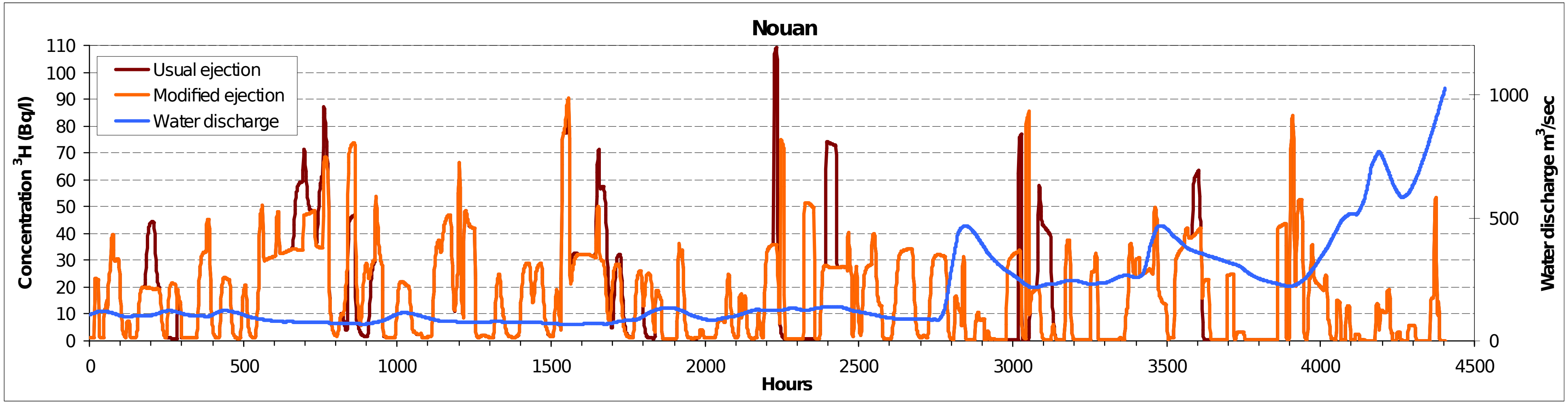

Fig. 5. Concentration of ^{3}H and water discharge in the point Nouan

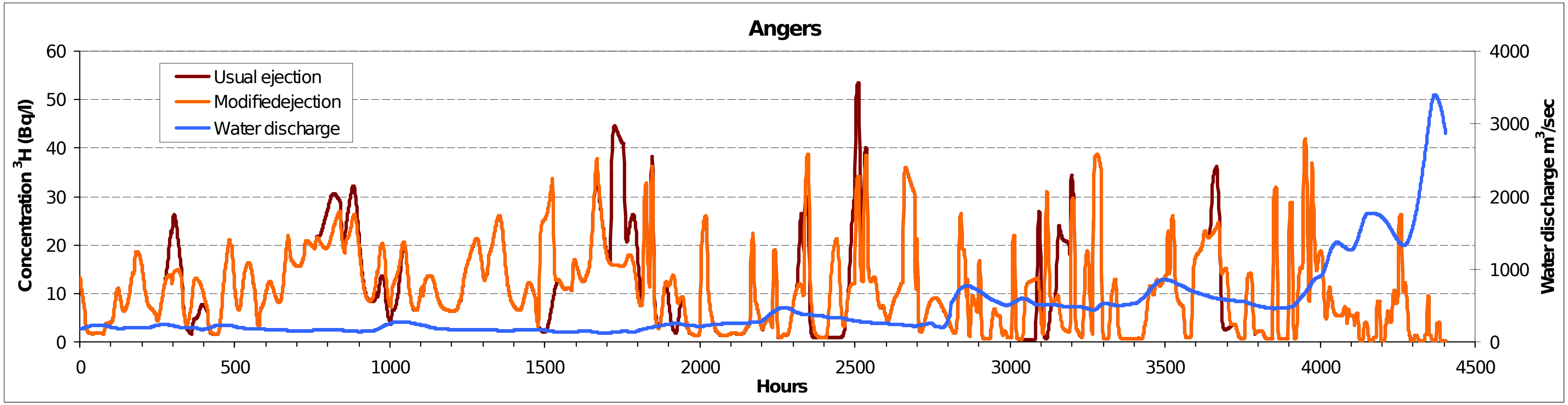

Fig. 6. Concentration of ^{3}H and water discharge in the point Angers

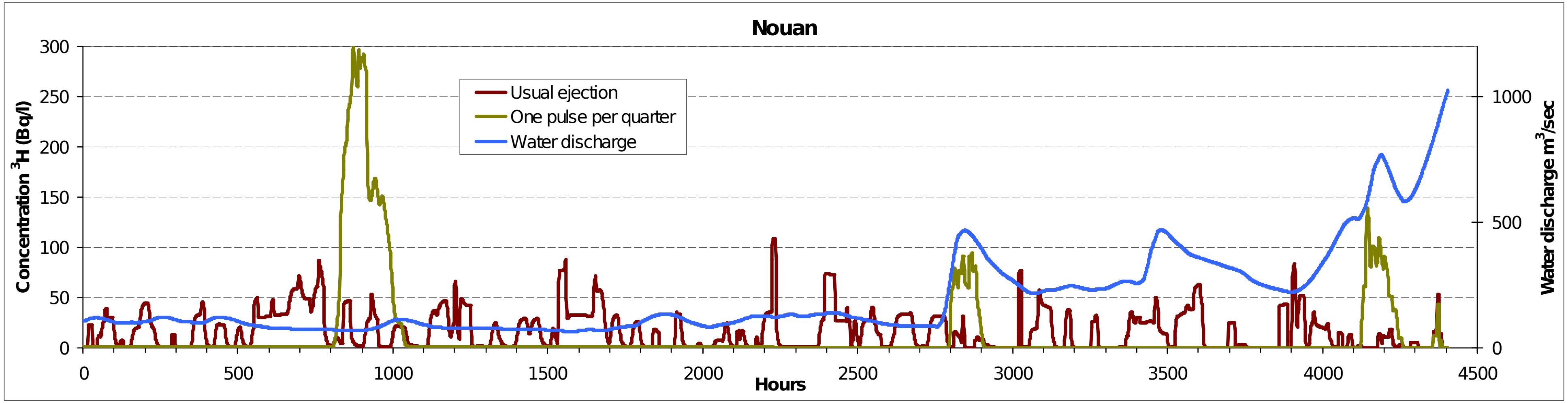

Fig. 7. Concentration of ^{3}H and water discharge in the point Nouan

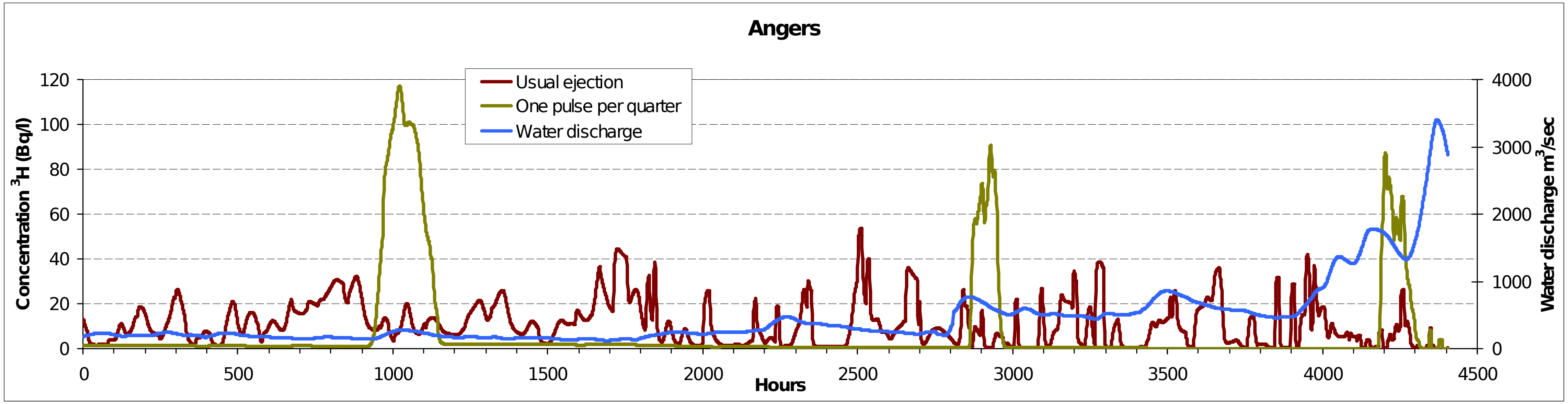

Fig. 8. Concentration of ^{3}H and water discharge in the point Angers

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REFERENCES

1. Sizonenko, V.P. 1998. Increasing accuracy of the box model. In: Hydroinformatics .98 - Proceedings of the Third International Conference on Hydroinformatics / Copenhagen / Denmark / 24-26 August 1998, V. Babovic & L.C. Larson (ed.), vol. 1, A.A.Balkema, Rotterdam, pp. 225-230.
2. Sizonenko V.P. 2000. The evaluation of influences of modes of operation the Kiev HPP on ^{90}Sr concentration in the outflow of the Kiev Reservoir. In: The Problems of General Energy. vol. 2, 2000, Kiev, pp. 58-63. (in Russian)
3. Testing of Models for Predicting the Behavi-our of Radionuclides in Freshwater Systems and Coastal Areas / Report of the Aquatic Working Group of EMRAS Theme 1, IAEA, 244p. http://www-ns.iaea.org/downloads/rw/projects/emras/final-reports/aquatic-tecdoc-final.pdf
4. Sizonenko, V.P. 2008. A case study for a numerical box model with lagging argument in order to simulate transportation of pollution in Dnieper reservoirs and Loire River "International Conference on Radioactivity in the Environment", 2008, Jun 15-20, Bergen, Norway, Abstract Volume, part 2, pp.225-231.